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DEPARTMENT OF AGRICULTURE,

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ENTOMOLOGICAL CIRCULAR NO. 12.

Insecticides and Fungicides.

BY

C. C. GOWDEY, B.Sc., F.E.S.,
GOVERNMENT ENTOMOLOGIST, JAMAICA.



JAMAICA
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1927.

ENTOMOLOGICAL PUBLICATIONS.

Persons engaged in any form of rural industry will receive such of the entomological publications of the Department free, except (a), as may be of use to them in their branch of agriculture on request to the Department.

CIRCULARS.

1. Directions for Killing, Preserving and Packing Insects.
3. The Citrus Black Fly.
4. The Fall Army Worm.
5. Prevention and Control of Insect Pests.
6. Control Measures Against the Citrus Black Fly.
7. Resuscitation of Decadent Citrus Groves.
8. The Banana Borer.
9. The Principal Insect Pests of Tobacco in Jamaica.
10. Citrus Cultivation.
11. The Sweet Potato Weevil.
12. Insecticides and Fungicides.

BULLETINS.

1. Coccidae of Jamaica. (Technical).
- (a) 2. The Principal Agricultural Pests of Jamaica. (Price 2/-, Government Printing Department, Kingston.)
3. White Flies (Aleurodidae) of Jamaica. (Technical).
- (a) 4. Catalogus Insectorum Jamaicensis, Pts. 1 and 2. (Technical). (Price 2/, Government Printing Department, Kingston).

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INSECTICIDES AND FUNGICIDES

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To a large extent the successful production of any crop, be it farm, orchard or garden crop, is dependent on the measures adopted to protect it against insect pests and fungoid diseases. The usual form of protection is by spraying, which every enlightened agriculturist should regard as much a part of the farm routine as, for instance, weeding.

The farmer must first ascertain the cause of the ailment, and then orient himself with the known facts of the habits of the causative agent and with the measures recommended for its control.

Spraying is often a failure because the farmer has not correctly diagnosed the cause of the ailment and, therefore, has not applied the proper remedy, or because he has not faithfully followed the recommendations. Or, the spraying may have been delayed until the pest has made its appearance and it is too late to ward off the injury for that season.

Spraying to be effective must be done thoroughly. This is especially true when the insect concerned is one which obtains its food by sucking the juices of the plants and which can only be killed by the spray coming into contact with it.

Given below are the formulas of spraying mixtures, and in each case mention is made of the kind of insect or fungus for which that particular spray is recommended.

FORMULA 1.

AMMONIA—COPPER CARBONATE.

Ammonia (26° B.)	..	3 pts.,
Copper carbonate	..	6 ozs.,
Water	..	50 gals.

Preparation:—Dissolve the copper carbonate in the ammonia and then add the water.

For use against fungi. Its use on nearly matured fruit is preferable to Bordeaux Mixture, since on drying it leaves no stain.

Note:—This spray should be used immediately after preparation, as it loses its strength on being exposed to the air.

FORMULA 2.

ANT SYRUP.

Arsenic, White	..	2 ozs.,
Lye, Concentrated	..	1 oz.,
Sugar, Brown	..	1 lb.,
Water	..	1 pt.

For use against household ants.

FORMULA 3.

BENZENE.

Application:—Dry the wound with cotton wool; apply the benzene immediately and dress the wound.

For use against the Screw Worm and other fly-larvae causing myiasis in the wounds of animals.

Note:—Benzene acts as a styptic and the blood flow ceases as soon as all the larvae are killed. It is non-toxic to the higher animals.

FORMULA 4.

"BLACK LEAF 40" OR NICOTINE SULPHATE.

"Black Leaf 40" or Nicotine sulphate	1 pt.,
Whale oil soap	4 lbs.,
Water	200 gals.

For use against Thrips, Mealy Bugs, and other 'soft' scale insects, Aphids and Leafhoppers.

Note:—The addition of soap, 2 lbs., increases the efficiency of tobacco sprays by rendering the solution alkaline, thus causing the release of the maximum amount of nicotine, which is the active principle of these sprays.

Both "Black Leaf 40" and nicotine sulphate can be used in combination with Bordeaux (Formula 12) and Lime-Sulphur Mixtures, but in such combinations soap must *never* be used. In such combinations, also, the nicotine ingredient should be added immediately before application and thoroughly agitated to ensure an even distribution of the nicotine ingredient.

FORMULA 5.

BODY-LOUSE POWDER.

Creosote	..	..	1 cc.,
Sulphur	..	..	$\frac{1}{2}$ gr.,
Talc	..	..	20 grs.

FORMULA 6.

BORAX.

Dosage:—1 lb. of powdered borax to 16 cu. ft., or 0.62 lb., per 8 bushels of manure.

For use against the larvae of the house fly and stable fly in stable manure and refuse heaps.

FORMULA 7.

BORAX—SODIUM ARSENATE MIXTURE.

Dosage:—(per 12 lbs. of manure): Borax, $11\frac{1}{2}$ ozs.; sodium arsenate, 7 ozs.; water, 1 gal.

For use against the larvae of the house fly and stable fly in stable manure and refuse heaps.

FORMULA 8.

BORDEAUX MIXTURE.

Copper sulphate	..	..	4 lbs.,
Lime, Unslaked	..	..	4 lbs.,
Water	..	..	50 gals.

Preparation:—Dissolve the copper sulphate in a gal. of warm water. After the lime has been thoroughly slaked, strain the resulting lime-water to remove the lumps. As soon as all the copper sulphate has dissolved, add the remaining amount of water. Then mix the copper sulphate solution and the lime-water, stirring during the mixing

The resulting mixture is Bordeaux Mixture.

For use against fungi.

Note:—Bordeaux Mixture should always be tested to make sure that enough lime has been added to combine with the copper sulphate and that there is no copper in solution, which would result in injury to the foliage. To test whether the copper sulphate has been neutralized by the lime—(a) On the addition of ferrocyanide of potassium to the mixture there is no change in the colour of the mixture, but if more lime is required the mixture changes to a reddish or purplish colour. (b) If sufficient lime has been used blue litmus paper remains unchanged, but if the amount of lime is insufficient blue litmus paper turns red. (c) If metallic copper precipitates on the blade of a knife, more lime is required.

Bordeaux Mixture decomposes on standing, but the addition of sugar, $\frac{1}{2}$ lb. to every 50 gals. of the mixture, will preserve it indefinitely.

Bordeaux Mixture may be used in combination with lead arsenate (Formula 9) or with Paris Green (Formula 10) for use against fungi and chewing insects, and with nicotine sulphate (Formula 11) for use against fungi and sucking insects, and with lead arsenate and nicotine sulphate (Formula 12) for use against fungi, chewing and sucking insects.

FORMULA 9.

BORDEAUX MIXTURE—LEAD ARSENATE.

Bordeaux Mixture	..	50 gals.,
Lead arsenate (dry form)	..	1-1 $\frac{1}{2}$ lbs.

Preparation:—prepare the Bordeaux Mixture in the usual way, add the lead arsenate slowly and stir thoroughly.

For use against fungi and chewing insects.

FORMULA 10.

BORDEAUX MIXTURE—PARIS GREEN.

Bordeaux Mixture	..	50 gals.,
Paris Green	..	$\frac{1}{2}$ lb.

Preparation:—Prepare the copper sulphate and lime solutions as described under Formula 8, but before mixing them use a little of the lime-water to make the Paris Green into a thin paste, then stir the paste into the remainder of the lime-water, and then mix the copper sulphate and lime-water, as described above.

For use against fungi and chewing insects.

FORMULA 11.

BORDEAUX MIXTURE—NICOTINE SULPHATE.

Bordeaux Mixture	..	50 gals.
Nicotine sulphate	..	$\frac{1}{2}$ pt.

Preparation:—Prepare the Bordeaux Mixture in the usual way and add the nicotine sulphate slowly, stirring constantly.

For use against fungi and sucking insects.

FORMULA 12.

BORDEAUX MIXTURE—LEAD ARSENATE—NICOTINE SULPHATE.

Bordeaux Mixture	..	50 gals.,
Lead arsenate (dry form)	..	$\frac{1}{2}$ lb.,
Nicotine sulphate	..	$\frac{1}{2}$ pt.

Preparation:—Prepare the Bordeaux Mixture in the usual way, add the lead arsenate slowly, stirring constantly, and then add the nicotine sulphate, stirring thoroughly.

For use against fungi, chewing and sucking insects.

FORMULA 13.

BRAN MASH.

A. Paris Green	..	2½ lbs.,
Bran	..	50 lbs.
B. Lemons, chopped finely		½ doz.,
Molasses	..	4 qts.,
Water	..	5 gals.

Preparation.—Mix A. dry. Mix B. Then mix A. and B together. Add enough water to make a wet mash.

Application.—Distribute broadcast early in the morning in the case of grasshoppers. In the case of cutworms place around the plants after sundown.

For use against grasshoppers and cutworms.

FORMULA 14.

CALCIUM ARSENATE.

Calcium arsenate (powder)		¾ lb.,
Lime, Slaked	..	2 lbs.,
Water	..	50 gals.

For use against caterpillars and other leaf-eating insects.

Note.—This insecticide has a high power of suspension and adhesiveness.

It is cheaper than lead arsenate, as lime is substituted for lead, and it is more efficient, since it contains a higher percentage of arsenic oxide, but it should not be used on delicate plants.

It may be obtained in three forms—acid, neutral and basic. The basic form is less soluble in water than the other forms and is, therefore, the most desirable.

It can be used in combination with Bordeaux and lime-sulphur mixtures, but in such combinations the lime should not be added.

FORMULA 15.

CALCIUM ARSENITE.

Arsenic, White	..	1 lb.,
Lime, Unslaked	..	2 lbs.,
Water	..	100 gals.

Preparation.—Boil the arsenic and lime together for 30 minutes in from two to five gallons of water and then make up the volume of the liquid to 100 gals. by the addition of water.

For use against chewing insects.

Note.—It may be used as a substitute for Paris Green, but only on plants resistant to arsenical injury.

FORMULA 16.

CARBOLIC ACID EMULSION.

Carbolic Acid, crude	..	1 gal.,
Whale oil soap	..	8 lbs.,
Water	..	8 gals.

Preparation.—Dissolve the soap in boiling water, add the carbolic acid and boil for ten to fifteen minutes, and when cool agitate vigorously.

Dilution.—Apply in the proportion of one part of the emulsion to 20 parts of water.

For use against Mealy Bugs and other 'soft' scale insects.

FORMULA 17.

CARBON BISULPHIDE.

This is a heavy liquid which rapidly evaporates, producing a poisonous, *highly inflammable* gas. It is used for destroying clothes pests, grain pests, subterranean pests, such as ants, root-lice and maggots, and borers in trees. For indoor fumigation it is used at the rate of 2 teaspoonfuls to every cubic foot of space and fumigation should last for from 24 to 48 hours. As the gas is so inflammable it should never be used in the proximity of fire, not even near a lighted cigarette, and, as it is much heavier than air, the vessels used as containers should be shallow and placed near the top of the space to be fumigated.

FORMULA 18.

CORROSIVE SUBLIMATE.

Corrosive Sublimate	..	2 ozs.,
Water	..	15 gals.

Preparation:—Dissolve the corrosive sublimate in a small quantity of hot water and then add the remaining water.

For use against scab of seed potatoes.

Note:—It should be contained only in glass, wooden or earthenware vessels.

It should be prepared only when required, as corrosive sublimate is precipitated by organic matter, or the strength of the solution maintained by the addition of the chemical from time to time.

FORMULA 19.

CORROSIVE SUBLIMATE—CARBOLIC ACID.

Corrosive Sublimate	..	1 oz.,
Carbolic Acid	..	1 oz.,
Methylated Spirit	..	1 qt.

Application:—Applied to the binding of books by means of a fine brush.

For use against silver fish and cockroaches attacking books.

FORMULA 20.

CREOSOTE.

Used against mosquito larvae and pupae in the form of a fine mist.

FORMULA 21.

CRIDDLE MIXTURE.

Paris Green	..	1 lb.,
Salt	..	2 lbs.,
Dung, Fresh horse	..	60 lbs.

Preparation:—Mix the Paris Green with water to form a paste; then stir the paste into the dung, into which the salt has been stirred.

Application:—Spread the mixture broadcast early in the morning.

For use against grasshoppers.

FORMULA 22.

CRUDE OIL.

Application:—Impregnate sawdust with crude oil; place the oil-soaked sawdust in bags and fasten the bags to the bottom of the stream.

For use against the immature stages of mosquitoes in moving water.

FORMULA 23.

CYANOGAS CALCIUM CYANIDE.

Dosage:—2 ozs. to the sq. yd. at a depth of 3 ins.

For use against soil-inhabiting insects, such as wireworms, May Beetles, Citrus Fiddler Beetle.

Note:—Better results are obtained in dry and light soils than in moist and heavy soils.

FORMULA 24.

DISTILLATE EMULSION.

Distillate (32° B.)	..	4 gals.,
Whale oil soap	..	$\frac{3}{4}$ gal.,
Water	..	200 gals.

Preparation:—Dissolve the soap in warm water and add the oil while the solution is still warm; agitate briskly until an emulsion is formed; then stir in the remaining water.

For use against Aphids, Mealy Bugs and other 'soft' scale insects.

FORMULA 25.

ENGINE OIL EMULSION.

Engine oil	..	2 gals.,
Water	..	1 gal.,
Potash Fish oil soap	..	2 lbs.

Preparation:—Emulsify by churning vigorously for several minutes. If any difficulty is experienced in emulsifying, the amount of soap may be increased.

Dilution:—1 part to 10 parts of water.

For use against Thrips, scale insects and Aphids.

FORMULA 26.

FORMALIN.

Dilution:—1.25 to 2.5% of 40% formalin.

For use against flies as a bait. It may also be used to control scab of seed potatoes, 1 pt. of 40% formalin to 30 gals. of water.

FORMULA 27.

HYDROCYANIC ACID GAS.

Potassium cyanide	..	1 part,
Sulphuric acid (fluid measure)	..	1 part,
Water	..	3 parts.

Or,

Sodium cyanide	..	1 part,
Sulphuric acid (fluid measure)	..	$1\frac{1}{2}$ parts,
Water	..	2 parts.

Preparation:—Pour the required amount of water into an earthenware or granite jar and add the acid slowly. Then drop in the cyanide, which has been broken into pieces about the size of an egg, and leave the building quickly. After fumigation the building should be opened and aired for about 30 minutes before entering.

It is used for destroying household, nursery, greenhouse and mill pests.

For household fumigation and fumigation of dormant nursery stock, use 1 oz. of potassium cyanide, or $\frac{3}{4}$ oz. of sodium cyanide, to every 100 cu. ft. of space. For household fumigation at least 12 hours is required for fumigation and for dormant nursery stock from 50 minutes to an hour.

Note:—This is one of the most deadly gases known and, hence, great care must be exercised in using it.

FORMULA 28.

KEROSENE EMULSION.

Soap, Hard	1 lb.,
Water	2 gals.,
Kerosene	4 gals.

Preparation:—Shave the soap finely and heat it in the water until dissolved. Pour in the oil while the soap solution is still hot. Agitate briskly until a creamy emulsion is formed.

Dilution:—To make a 10% emulsion for summer spraying, add 34 gals. of water.

For use against most sucking insects, as, for instance, scale insects, the Citrus Black Fly, Aphids, etc.

FORMULA 29.

KEROSENE—FUSEL OIL EMULSION.

Whale oil soap	4½ lbs.,
Fusel oil	1¾ pts.,
Kerosene	1¾ gals.

Preparation:—Mix the fusel oil and kerosene together, then dissolve the soap in the mixed oils and emulsify by brisk agitation.

Dilution:—1 part of the emulsion to 10 parts of water.

For use against sucking insects.

FORMULA 30.

LEAD ARSENATE.

(a) Paste:

Lead arsenate	4 lbs.,
Water	100 gals.

(b) Powder:

Lead arsenate	2 lbs.,
Water	100 gals.

The powder form may be applied either as a spray, or as a dust, in which case it should be mixed with lime in the proportion of 1 : 10.

For use against leaf-eating insects.

Note:—(a) is obtainable in three forms—acid, neutral and basic; (b) only in the acid form. The acid form has a lower specific gravity, hence higher suspension, and is more active than the other salts. The acid and neutral forms are practicably insoluble in water, and, hence, are the safest forms to use.

Lead arsenate has a low arsenic content, so it is slow acting in comparison with Paris Green and Calcium arsenite, but in most cases its use is preferable to either of those, as it is safer on account of its insolubility and it is more adhesive.

It is sometimes necessary to add substances to increase the sticking or spreading factors, thus increasing the efficiency and decreasing the disfigurement of the crop. The addition of casein, 3 ozs., and fine slaked lime, 7 ozs., to 50 gals. of the lead arsenate spray increases the sticking quality. The mixture of casein and lime should be mixed with a little water to form a paste and then added to the spray. The addition of fish oil soap, 2 lbs., to the lead arsenate spray increases the spreading quality. The soap should be dissolved in a little water and added to the lead arsenate spray.

Lead arsenate can be used in combination with Bordeaux Mixture (Formula 9) to control at the same time both leaf-eating insects and fungi.

FORMULA 31. LONDON PURPLE.

London Purple	..	1 lb.,
Lime, Unslaked	..	2 lbs.,
Water	..	100 gals.

Preparation:—Slake the lime with hot water and dilute with the full amount of water. Add enough lime-water to the London Purple to make a paste, then add the paste to the lime-water and stir well.

Note:—London Purple has gone out of favour owing to its very variable composition and, as it usually contains a high percentage of soluble arsenic, it is unsafe to use as a spray. It may, however, be used as a substitute for Paris Green in Formula 13.

FORMULA 32.

L. & V. FLUOSILICATE DUSTING POWDER.

L. & V. Fluosilicate Powder	1 part,
Lime, Slaked	9 parts.

For use as a dust against leaf-eating insects

FORMULA 33.

NICOVOSS.

Nicovoss	..	1/2 lb. (2/5 pt.),
Soap, Soft	..	1 lb.,
Water	..	12 gals.

Preparation:—Dissolve the soap in 2 gals. of water; add the remainder of the water and stir in the Nicovoss.

For use against Aphids and the Citrus Black Fly.

FORMUAL 34.

OIL—TAR—PENNYROYAL MIXTURE

Fish oil	..	1 gal.,
Tar, Oil of	..	2 ozs.,
Pennyroyal, Oil of	..	2 ozs.,
Kerosene	..	1/2 pt.

Used to repel flies from animals.

FORMULA 35.

PARADICHLOROBENZENE.

(a) Against Root-Grubs attacking Citrus:

Dosage:—1 oz.

Application:—Level surface of soil around the base of the trees; sprinkle the Paradichlorobenzene in a continuous band 4 inches from the trunk of the trees; cover the band with soil to a depth of 4 inches and pack the soil with a shovel.

(b) Against Root-Grubs attacking Sugar Cane:

Dosage:—1/4 oz.

Application:—Apply in small holes 4 inches deep, about 18 inches apart, and about 6 inches from the stool.

(c) Against Subterranean-Nesting Ants:

Dosage:—1/4 oz.

Application:—Insert the Paradichlorobenzene into the nests to a depth of about 6 inches by means of a short piece of iron pipe about an inch in diameter; cover the nest with damp soil and pack the soil with a shovel.

Note:—Paradichlorobenzene is insoluble in water, non-poisonous and non-inflammable.

It will not act in wet soil and is not effective in clayey soil. In dry soil the average period of vaporisation of one ounce is about seven weeks. The vapour is about twice as heavy as that of carbon bisulphide

FORMULA 36.

PARIS GREEN.

(a) As a Spray:

Paris Green	..	1 lb.,
Water	..	180-200 gals.,
Lime, Unslaked	..	2 lbs.

Preparation:—Slake the lime in hot water and add enough cool water to the required volume. Add enough of the lime-water to the Paris Green to form a paste, add the paste to the lime-water and stir well.

(b) As a Dust:

Paris Green	..	1 lb.,
Lime, Fine, freshly slaked		6 lbs.

For use against chewing insects.

Note:—A good sample of Paris Green should not contain less than 50% arsenous oxide and more than 3.5% soluble arsenous oxide.

FORMULA 37.

POTASSIUM SULPHIDE.

Potassium sulphide	..	3 ozs.,
Water	..	10 gals.

Preparation:—Dissolve the potassium sulphide in a small quantity of water and then add the remainder of the water.

For use against the powdery mildew of roses.

Note:—The spray should be prepared only as it is required, as it loses its strength on standing. The potassium sulphide should be kept in a well-stoppered bottle.

FORMULA 38.

RESIN WASH.

Resin, Powdered	..	10 lbs.,
Soda, Caustic	..	2½ lbs.,
Whale oil soap	..	20 ozs.,
Water	..	5 gals.

Preparation:—Boil the resin and caustic soda in 1 gal. of water until the resin is melted; add the soap and boil until the liquid becomes dark brown (one to two hours); add the remainder of the water before removing the vessel from the fire and stir well.

Dilution:—1 part of the resin wash to 16 parts of water.

For use against scale insects and Thrips.

FORMULA 39.

SELF-BOILED LIME-SULPHUR MIXTURE.

Lime, Unslaked	..	8 lbs.,
Sulphur	..	8 lbs.,
Water	..	50 gals.

Preparation:—Place the lime in a barrel; slake with a small amount of water; sieve the sulphur and add slowly to the slaking lime; add enough cold water to complete the slaking, stirring constantly. When slaking is finished (from 5-15 minutes) add the required amount of water.

For use against scale insects and Thrips.

Note:—Owing to the low suspension of the ingredients, constant agitation is necessary.

As the mixture leaves a deposit on fruit, it should not be applied when fruit are approaching maturity.

FORMULA 40.

SODIUM FLUORIDE.

(a) Scatter about haunts of cockroaches and blow into cracks with a dust-gun or blower.

For use against cockroaches.

(b) Dust poultry lightly with a commercial grade, 90-97%.

For use against the chicken louse.

FORMULA 41.

SODIUM SALICYLATE.

Sodium salicylate, aqueous solution 1%,

Sugar, Brown, aqueous solution 10%.

For use as a bait for the house fly.

FORMULA 42.

SUNOCO.

Sunoco 1 part,

Water 50 parts.

For use against scale insects, Aphids, the Citrus Black Fly and Thrips.

Note:—It can be used in combination with Bordeaux Mixture, but in such a combination the oil should be used at the rate of 2 parts to 50 parts of Bordeaux Mixture

FORMULA 43.

TOBACCO.

Tobacco refuse 1 lb.,

Water 2 gals.

Preparation:—Soak the tobacco in the water for 24 hours, stirring occasionally, and then strain the liquid.

For use against Aphids and the Citrus Black Fly.

Note:—The addition of soap increases the efficiency of this spray by rendering the solution alkaline, thus causing the release of the maximum amount of nicotine, which is the active principle.

It can be used in combination with Bordeaux Mixture (Formula 11) to control the above insects and fungi in one operation. But when so combined soap must *never* be used. Also, the nicotine ingredient should be added immediately before the spray is required for use and thoroughly agitated to ensure even distribution.

FORMULA 44.

WHALE OIL (FISH OIL) SOAP.

Whale oil (Fish oil) soap 1 lb.,

Water 6 gals.

Preparation:—Dissolve the soap in 1 gal. of hot water, stirring constantly, and then dilute to the required volume.

For use against most sucking insects.

Note:—The above formula is for caustic soda soaps, which contain about 50% less water than potash soaps and are hence stronger than

the latter; consequently, if potash soaps are used about twice the quantity should be used to the same amount of water.

The addition of 1 oz. (fluid) of "Black Leaf 40" to every 6 gals. of the caustic soda soap solution, or to every 3 gals. of the potash soap solution, increases their efficiency.

FORMULA 45.

WHITEWASH.

Lime, Slaked	..	25 lbs.,
Sodium phosphate	..	1½ lbs.,
Milk, Skimmed	..	2 gals.,
Water	..	10 gals.

Preparation:—Mix the lime and water, stir in the phosphate and then add the milk.

• FORMULA 46.

WOOL SOAP.

Wool Soap	..	1 part,
Water	..	50 parts.

For use against scale insects, Thrips, Aphids and the Citrus Black Fly.

Note:—It can be used in combination with Bordeaux Mixture to control the above insects and fungi in one operation, but in such a combination the soap should be used at the rate of 2 parts to 50 parts of Bordeaux Mixture.

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